SOFT COMPUTING APPROACHES FOR LEARNING PREDICTIONS USING FUZZY LOGIC AND NEURAL NETWORK

A

Synopsis

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1. Abstract of Proposed Research

For improving the excellence and quality of e-learning, selection of suitable e-content is very important which is based on learning style of individuals. As psychology of individuals for learning is varying in nature and diversified based on various factors such as environment, their mood, and time and learning patterns. Again knowledge about learners for prediction of learning style is uncertain in nature. Our work proposes personalized experience to learner by recommending him/her study material according to his/her requirement, goals caliber, interest and mood. A fuzzy logic and neural network based frame work helps to suggest the learners to increase their satisfaction in the given subject, so that they can enhance their learning experience. At the same time knowledge and study material provider provide their skill and material to the learners accordingly, so most of the e-learners get benefit. Now fuzzy logic and neural network base approach gives performance evaluation of e-learners as well as e-learning providers.

2. Introduction

E-learning is methodology as defined by Chen et.al (2004), refers to the delivery of information and knowledge at anywhere, any time and to anybody. E-learning reduces time, efforts and cost of teaching and learning. Flexibility, personalized learning, intelligent tutorial system, knowledge development and continual assessments are the factor which improves the importance of E-learning. Success or failure of E-learning is depends on many factors, such as learning objects, delivery of learning objects, related information retrieval, management of knowledge, impact of learning style, evaluation of performance and many more factors which vary from learners to learners[8].

1.1 **Overview of Educational System** :-

The various educational systems available are offline learning system, E-learning system, adaptive learning system, collaborative learning, intelligent tutorial system, learning system with learning style predictors etc[2]. Objectives of education is achieving goal of individual by adapting any of combination of above system available for education. At the same time efforts and interest factors should be consider during study. In the past decade the continuous use of computer and internet, technologies has changed the way learning and teaching in the field of education. Web base education system offers easy access to knowledge domain. Learning process became easy for everybody at any time, from anywhere. As a result of this user's of web base educational system are of varying background with heterogeneous needs, different knowledge level and abilities. This fact emphasizes the need to develop web base educational system which offers dynamic adaptation to each individual student.

1.2 **Overview of learning styles** :-

Learning style is a particular way in which individual learns. Number of techniques and instruments and ways are available in learning and teaching activity. Questionnaires, interviews, discloser of profiles information, talk shows have been identified in the past to predict the learning style of learners may be suitable for traditional class room setting environment.

In 21st century as learners, various subjects and huge knowledge goes on increasing. The traditional method and ways are insufficient for knowledge sharing. The same method is applicable for all learners who are learning at same time. In the Era of digital word this way is ineffective, time consuming and require lots of efforts[3]. Revolution in learning, training field in the recent years emerges E-learning concept. The most effective way to enhance user's experience will provide them personalized learning environment based on his interest, profile, future and feedback. E-learning is based on the use of ICT i.e. Information And Communication Technology and its most important characteristics. E-learning offers distance learning and training to user based on their requirement and caliber. For personalized learning, e-learning is best option which gives content of web to the specific and individual needs. Personalization of learning is one of the most important ways of improving the effectiveness of education. At the same time the above process requires numerous factors such as learners profiles, learning strategies, learning material and goals make the process complex.

All learners will not have to follow the same instructional model. All learners should not be advised to read same material in same order. Hence learning material should deliver to learners with respect to student's knowledge level and personal need [5]. Adaptive and collaborative E-learning systems can give electronic course materials and services on individual basis and hence accommodate large variety of learners. Many dynamically interactive components involved in developing such system and made it complex.

We propose Fuzzy and Neural network base recommender system for personalized E-learning to further enhance his capabilities and attainment of his goals. With the help of smart and intelligent computer systems, it is possible to solve these problems. The system perceives their design objectives. The system helps to learn from their past experiences which help them in decision making in future situations.

A deep understanding of one's own way of learning can be analyzed by the behavior of the learners involved E-learning. This lead to increase personal empowerment and self confidence. The learner's web browsing activity helps for identifying behavior of learners in E-learning environment. Finding knowledge and behavior about the learner's is usually critical and uncertain.

The proposed research work finds the various E-learning methods used and adaptive instructions in an E-learning environment. The modules in research work recognize the users changeable state [like knowledge level , mood]and existing dependence among the element [like concept, preferences, events].Then this module became novel generic tool for adaptive processes concerning user modeling. The fuzzy set with models contributes to the improvement at the efficiency of dynamic adaptation to user's needs and preferences of adaptive system. The proposal gives several approaches using fuzzy logic technique to provide practical method of evaluating student's performance and comparison with existing statistical method [which helps in evaluating teacher's overall performance based on Fuzzy logic techniques].The fuzzy set gives student's knowledge level as subset of the domain knowledge. Fuzzy clustering technique analyzes the behavior of students. It employs a novel inference mechanism that dynamically updates user's requirements using fuzzy set. The student's knowledge fraught with uncertainty and possible approach to deal with this fuzzy logic. This combination is more significant because it represents student's knowledge level in more realistic way by automatically modeling, learning and forgetting process of students. The representation of relations of

learning materials domain concept is performed by Fuzzy Cognitive Map[FCM], which helps to compute the “strength of impact” of these elements. We learn Felder and Silverman learning style model for study of adaptive E-learning system.

1.3 Objectives of learning

Learning objectives are statement that defines the expected goal of curriculum, course, lesson or activity in terms of demonstrable skills or knowledge that will be acquired by students as a result of instructions. Learning objectives are a way for teachers to structure, sequence and plan out the learning goals for a specific instructional period, which is typically for the purpose of moving students towards the achievement of larger and longer term educational goals.

1.4 Objectives of E-learning

1. Before achieving higher order learning objectives, E-learning professionals should first make sure that learners have all the necessary requirement in terms of previous knowledge in order to proceed.
2. A pretest for instance may be used to identify potential knowledge gaps and recommended learners a quick revision before taking the module under consideration.
3. Align E-learning with your learning objectives.
4. Remember to use specific and measurable verbs when writing them.
5. Make sure that your learning objectives are appropriate for your learners.
6. Use simple language and keep them short.
7. Ask yourself whether your learning objectives are realistic and achievable.

1.5 Overview of fuzzy Logic and Neural Network:

In today's environment and prediction problems researchers often fail to make precise statement about input and outputs. Soft computing is the use of exact solutions to computationally hard task for which there is no known algorithm that can compute exact solution. Unlike hard computing, which strive for exactness and full truth, soft computing techniques explicit the given tolerance of imprecision, partial truth and uncertainty for particular problem. It has low solution cost. Various Soft computing techniques such as Fuzzy Logic, neural networks, genetic algorithms have had significant and growing impact [9]. Fuzzy logic is powerful methodology for solving problems with many application in information processing, future predictions, risk assessment cost benefit analysis, life cycle impact assessment etc. Fuzzy logic based methods should be further investigated as alternatives and perhaps more appropriate methods to confront uncertain and complex b. Fuzzy arithmetic works well for addressing linguistic variables and poorly characterized parameters. Fuzzy methods offer opportunity to evaluate and communicate assessment based in linguistic terms which possibly match those public decision makers. It do not require well characterized statistical distribution input. Fuzzy also provide rules for combining quantitative and qualitative objectives.

3. Review of Literature and Development in the Subject

"Adaptivity based on Felder-Silverman learning style model in E-learning systems" by Birol Ciloglugil shows adaptivity in E-learning system can be provided by efficient modeling of the learners [1]. Modeling of learners or students was based on their individual needs, preferences and differences. Adaptivity proposes are for, learning style model as they model how [learners] users learn in effective way. Again they use Felder and Silverman learning style model which is widely used model in E-learning field. This research helps to evaluate contribution and performance of different data sources and attributes used in learning styles prediction models and tools. Comparison and combination of different models are also performed in this work.

"Fuzzy Logic Based Learning Style Prediction in E-learning using Web Interface Information" by L Jegatha deborach et.al. The researcher of this title uses fuzzy logic for E-learning. The e-learners excellence can be improved by recommending suitable E-contents available in E-learning servers based on learning style. E-learners are diversified based on the learning pattern, environment, time and their mood. In this paper they identifies Felder-Silverman Learning Style model as suitable model for learning style prediction especially in web environment and use Fuzzy rules to handle the uncertainty in learning style prediction. They also used Gaussian membership function based Fuzzy logic.

Konstantina Chrysafiadi and Maria Virvou presented research in "Fuzzy logic for Adaptive Instruction in an E-learning environment for Computer programming" [2]. They represent a novel approach to web based education which performs individualized instruction on programming languages which was fully implemented and evaluated in an educational application. Fuzzy set help to represent student knowledge level. It uses Fuzzy set to represent a student's knowledge level as subset of domain knowledge.

Himanshu Pandey and V.K Singh present their work in “A Fuzzy logic based Recommender System for E-learning system with Multi-Agent Framework” [3]. Multi-agent [computer system] based E-learning framework is proposed by author which help to provide personalized experience to the learner by recommending him study material according to his requirement, goals and caliber. Fuzzy logic based recommended agent framework to increase satisfaction and enhance personalized learning experience.

“Student Performance Evaluation: A fuzzy logic reasoning approach” by Ashwani Kharola, Swarnima Kunwar, Gopa B. Choudhary presents Fuzzy logic reasoning based approach for performance evaluation logic reasoning based approach for performance evaluation at student in school or college[4]. The data for evaluation cover academic as well as personality traits at the student. For that they used a stage-wise fuzzy reasoning approach to eliminate the issues at rule explosion. They also compare fuzzy and traditional technique which shows advantages of weightage allocation in fuzzy approach. The simulation result proved the validity of proposed technique.

Khalid Almohammadi and at. El. In their research “An interval Type -2 Fuzzy Logic Based System with User Engagement Feedback for Customized Knowledge Dilivery with Intelligent E-learning Platforms” presents adaptive educational system for intelligent E-learning [6]. They uses novel interval type -2 fuzzy logic based system that can learn the user’s preferred knowledge delivery, needs and preferred learning style basec on utilizing visual information for automatic calculation of engagement degree. This type -2 fuzzy logic based system has ability to handle linguistic uncertainties to produce better performance in compare to type -1 based fuzzy system.

“Fuzzy Logic Approch for Adaptive Test Sheet Generation in E-learning” represented by Mukta Goyal, Divakar Yadav and Alka Choubey [10]. For better adaptation or personalization they propose an e-test classify based on Bloom’s

classification or taxonomy of learning objective for different type of learner model. They used fuzzy approach to evaluate student preferable test in e-learning environment.

"Fuzzy logic application in evaluating financial performance: A case study of services sector in Malaysia", by Norasyikin Abdullah Fuhani et. al.[15]. The aim of their research is to evaluate financial performance of companies from services sector in Malaysia using Fuzzy logic approach. Using three steps of methodology they find ranking of companies. This ranking helps to suggest the investor that on which companies to invest based on their financial performance. Their method or approach is an alternative ways for traditional valuation.

4. Objectives of Research

1. To Handle uncertainty in the learner's behavior through the information acquired from their profile information and online web user activity.
2. To Classify E-learners on their behavior and interest.
3. To Find the unknown category of learners.
4. To Intimate E-learning developers for developing the product according to learners behavior.
5. How teaching syllabus is presented to learner to fit his/her personal need.
6. The fuzzy logic rule and neural network is used for accurately categorizing the learners even without complete information.
7. To Resolve the issue with the other dimensions of learning style, model namely sensing / intuitive, visual/verbal and sequential/ global.
8. To promote adaptively personalized education.
9. To identify the alteration on the state of student's knowledge level updates the learning overlay model and make dynamic decisions.

5. Methodology

Fuzzy Cognitive Map (FCM) : Fuzzy Cognitive Mapping is combination of fuzzy logic and cognitive mapping, and it is a way to represent knowledge system which are characterized of uncertainty and complex processes. Fuzzy cognitive map were introduced in 1986 – 1992 and since then they have gradually emerged as powerful paradigm for knowledge representation and reasoning which are essential for intelligent system. They represent real world dynamic systems, in a form that corresponds closely to the way humans perceive it [7].

FCM is the technique used for casual knowledge aquaization and representation which aim at solving decision making problem, modeling and simulate complex system. Spreadsheet and table are used to map FCM into matrices for further computations.

It is map with in which the relations between elements (e.g. concept, events, projects etc.) of mental landscape can be used to compute "strength of impact" of these elements. FCM is formal way of representing social scientific knowledge and modeling decision making in social and political system, then brought in the computation fuzzy logic.

FCM illustrate the whole system as combination of various concept and no of relationship that exist between its concept. A FCM consist of nodes (N1, N2, ….Nn) for representing the important elements of mapping system, and directed arcs (eij) which represent casual relationship between two nodes (Ni, Nj) . It is labeled with fuzzy values in interval [-1, 1]. Indication of positive causality between two factors is indicated by the positive value and negative causality is indicated by negative value[9].

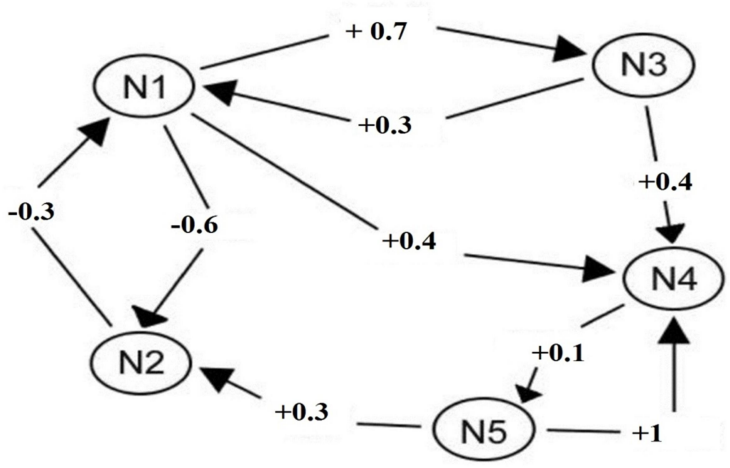

Fig. 1 Fuzzy Cognative Map

Following is the formulation of FCM which has four tuple (N, E,C, f) where

1. N = {N1, N2, …….Nn} is the set of n concepts forming the nodes of graph.

2. E: (Ni, Nj) -→ eij is a function of N x N to K associating eij to pair of concept (Ni, Nj), with eij denoting weight of directed edge from Ni to Nj if i≠j and eij equal to zero if i=j. Thus E(NxN) = (eij) € Knxn is connection matrix.

3. C:Ni -> Ci is function that at each concept Ni associate the sequence of its activation degrees such as for t € N, Ci(t) € L given its activation degree at moment t. C(0) €Ln indicate the initial vector specifies initial values of all concept nodes and C(t) €Ln is a state vector at certain iteration L.

4. F:R -> L is transformation function which includes between C(t+1)and C(t).

For all I € {1, 2 …., n}, C(t+1) = f(Σn j≠1 i = 1 eij Cj(t)

The transformation function is used to confine the weighted sum to certain range, which is usually set to [0,1].

2. Fuzzy Inference System (FIS) :

Fuzzy rule based system also called as fuzzy inference system (FIS) which helps to take decision in any situation anywhere with any data. This inference mechanism generally based on fuzzy rule which are based on IF-THEN condition along with 'OR' and 'AND' connectors. Fuzzy inference consist of five blocks such as rule base, membership function database, decision making, fuzzification interface and defuzzification unit[9]. First the initial values are fuzzified. From that fuzzy rules are formed and stored in database of rule. The deduzzifiction unit produces the crisp output. For taking decision by decision system rules from rule base are used by the defuzzification block.

This module checks the initial knowledge level of student, after learning the concept provided in the e-learning materials. The knowledge level of student is detected by conducting test on knowledge level. The FIS uses fuzzy rules to check which concept is understood by the learner or not. In the initial phase of FIS, fuzzy rules are generated from the given data set. The student knowledge level (KL) is identified based on the initial fuzzy rules.

3. Adaptive Neuro Fuzzy Inference System (ANFIS) :

Adaptive neuro fuzzy system is a kind of adaptive network that works equivalent to fuzzy inference system. The neuro adaptive learning technique provides the fuzzy models, to learn the knowledge present in input database. The learning technique assist FIS to compute the membership function and its work similar to neural network. During learning step of neural network the membership will vary. A gradient decent function is used to adjust the parameter in fuzzy rules. ANFIS uses back –propagation for parameter computation in the parameter estimation [9].

The initial fuzzy rules are constructed to identify the concepts which are understood by the student. If the particular concept is not understood by the learner, then ANFIS system will generate the new rules to detect the error rate (concept that are not understood) the parameters in rules are estimated again. The ANFIS will provide the different material if

the target level of student is not reached. This process will be repeated until the learner satisfaction.

4. Fuzzy Logic Based Multi Agent System:

Multi agent based e-learning using fuzzy logic is a way to make machines more intelligent which enabling them to reason in a fuzzy manner like human[13]. This method provide a personalized experience to the learner by recommending him/her study material according to requirement, goles and caliber. This method uses PDT tool to insure consistency[3]. The various agents that collaborate personalized learning are:

4.1 User: User is learner who has signed for any course. Users enter their details and learning goals.

4.2 Knowledge Database : This consist of all account details of various learning along with their reports that shows their performance. It also consist of various user feedback regarding any course that they have taken, various course structure and study material for learning.

4.3 Interface agent: User query Communicates to the task agent through interface agent. It also filters and retrieved documents from task agent that satisfy user need properly.

4.4 Task agent: It communicates the terms of learner's query to the information agent, and get those document from every information agent that better fulfils the query. Analyzing them and resolving the possible conflicts among the information agent. (generally one task agent for one interface agent).

4.5 Information Agent: Which receive user query from the task agent and look for the document in the information base. For various domain course there can be multiple information agent specified which provide learning material to task agent.

4.6 Recommender Agent : This agent is primarily responsible for recommending new learning material to user which is depending on two input : user feedback about various learning material and learning report that denotes his performance and his goal attended so far.

4.7 Database Management Agent : Knowledge database is managed by this agent. Two section of this agent is : first section consist of all the course structure and learning material, the other section consist of account detail of all user with their reports and feedback.

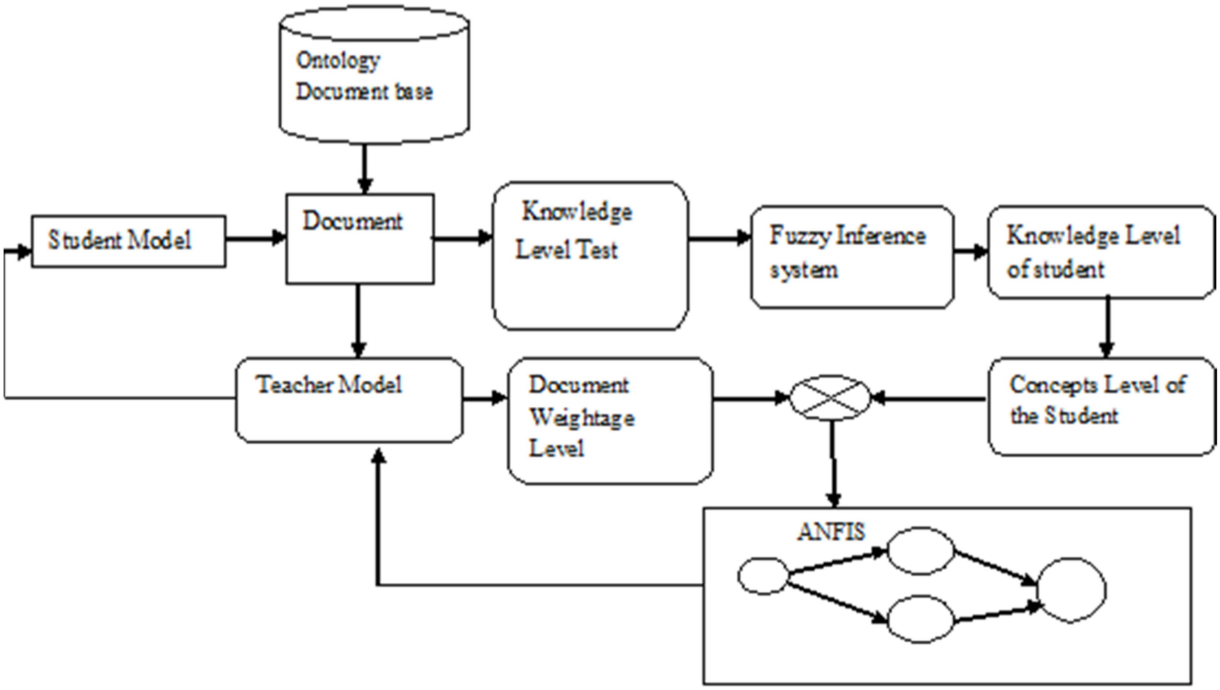

Fig. 2 Over all Architecture Diagram with FIS and ANFIS

6. Significance of Study and Application

Significance of Study:

The significance of study is that to promote adaptivity and personalization in educational applications on the basis of behavior and interest. For that fuzzy logic and neural network is used, which identifies the alteration on the state of student's knowledge level.

A general connection model of fuzzy decision making system helps to combine hybrid learning scheme and self organized and supervised learning scheme. The study introduces low level learning power of neural network into fuzzy logic system and provides high level human understandable meaning.

Using fuzzy inference system and ANFIS it is possible to retrieve and store e-learning material in knowledge database. Neural network is trained to identify the knowledge level of student. Te different materials are provided again and again to train the student until it achieves the result. But this material is provided based upon learner's need, mood and behavior which improve result faster and accurately. Refinement of fuzzy rules can be done to optimize the result.

Applications:

The applications of this innovative approach are possible where the user's changeable state and preference are affected by existing dependencies on system element. Especially this approach can be used in shopping moll, e-shopping, online examination, or multiple choice of elements are available. The proposed study can further extended and used for performance evaluation of employee, faculty etc**.**

International Status: It is intended to validate the result of research by application of researcher's tools with global parameters for international applications**.**

National Status: As we are very much familiar with our local students, it is easier to understand the learning styles so that we can apply this research work for our citizens more effectively.

7. Proposed Work Plan

Month wise plan for work to achieve Target are follows

Time Period	Planned work	Target to be Achieved
0 to 4 months	Study of various research topic under broad domain and selection of topic.	Study of various IEEE research papers. Selection of e-learning related topic. Objectives of learning. Learning existing learning methods. Online and offline learning. Concept of e-learning. Other materials for learning through website, you-tube etc.
4 to 8 months	Study of Existing research. Discussions with experts and guide. Study of existing applications.	Study of IEEE and other research papers related to topic. Learning the concept of fuzzy logic and neural network. Learning various methodologies such as FIS, ANFIS, FCM etc.
9 to 14 months	Study of various e-learning software, websites and online exam pattern.	Collecting data from various sites and institutes for processing.
14 to 18 months	Applying methodology.	Experimental work. Improvement in applications.
18 to 24 months	Result discussions.	Finding conclusions. Preparing reports.

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